PROPOSED TOTAL MAXIMUM DAILY LOAD (TMDL)

For
Fecal Coliform
In
C-25 Canal West
(WBID 3160) and
C-25 Cowbone Creek (WBID 3189)

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September 2006

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LIST OF ABBREVIATIONS

AWT	Advanced Waste Treatment
BMP	Best Management Practices
BPJ	Best Professional Judgment
CFS	Cubic Feet per Second
DEM	Digital Elevation Model
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
F.A.C.	Florida Administrative Code
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer Systems
NASS	National Agriculture Statistics Service
NLCD	National Land Cover Data
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OSTD	Onsite Sewer Treatment and Disposal Systems
PLRG	Pollutant Load Reduction Goal
Rf3	Reach File 3
RM	River Mile
STORET	STORage RETrieval database
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WBID	Water Body Identification
WLA	Waste Load Allocation
WMP	Water Management Plan
WWTF	Wastewater Treatment Facility

SUMMARY SHEET
Total Maximum Daily Load (TMDL)

1. **303(d) Listed Waterbody Information**
   State: Florida
   Major River Basin: St. Lucie River Basin

Impaired Waterbodies for TMDLs (1998 303(d) List):

WBID	Segment Name and Type	River Basin	County	Constituent(s)
3160	C-25 Canal West	St.Lucie	St. Lucie, Indian River and Okeechobee	Fecal Coliform
3189	C-25 Canal West	St.Lucie	St. Lucie, Indian River and Okeechobee	Fecal Coliform

2. **TMDL Endpoints (i.e., Targets) for Class III Waters (fresh and marine):**
   Fecal Coliform: 400 MPN/100ml

3. **Fecal Coliform Allocation:**

WBID	WLA FLA139254	WLA_{MS4}	LA	TMDL	Reduction
3160	0 counts per 100 ml	97 percent reduction	97 percent reduction	97 percent reduction	97%
3189	N/A	97 percent reduction	97 percent reduction	97 percent reduction	97%

4. **Endangered Species (yes or blank): Yes**

5. **EPA Lead on TMDL (EPA or blank): EPA**

6. **TMDL Considers Point Source, Nonpoint Source, or both: Both**

7. **Major NPDES Discharges to surface waters addressed in TMDLs:**

St. Lucie County MS4 (FLR04E029)
Indian River County MS4 (FLR04E068)
Larson Dairy Barn #3 (FLA139254)

TOTAL MAXIMUM DAILY LOAD (TMDL)
FECAL COLIFORM IN WATER BODY IDS 3160 AND 3189

1. INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not meeting water quality standards. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Florida Department of Environmental Protection (FDEP) developed a statewide, watershed-based approach to water resource management. Under the watershed management approach, water resources are managed on the basis of natural boundaries, such as river basins, rather than political boundaries. The watershed management approach is the framework FDEP uses for implementing TMDLs. The state's 52 basins are divided into 5 groups. Water quality is assessed in each group on a rotating five-year cycle. The Group 2 basin is shown in Figure 1 and includes the St. Lucie and Loxahatchee River Basins (Figure 2). The St. Lucie and Loxahatchee Basins encompass many square miles. To provide a smaller-scale geographic basis for assessing, reporting, and documenting water quality improvement projects, the FDEP subdivided the Group 2 area into smaller areas called planning units. Planning units help organize information and management strategies around prominent subbasin characteristics and drainage features. To the extent possible, planning units were chosen to reflect subbasins that had previously been defined by the South Florida Water Management District (SFWMD). The St. Lucie and Loxahatchee Basins contain eight planning units: C-25/Basin 1, North St. Lucie, C-24, C-23, South St. Lucie, C-44, Loxahatchee, and Coastal. Water quality assessments were conducted on individual waterbody segments within planning units. Each waterbody segment is assigned a unique waterbody identification (WBID) number. Waterbody segments are the assessment units or polygons that have historically been used by the FDEP to define waterbodies in their biannual inventory and reporting of water quality to EPA under Section 305(b) of the federal Clean Water Act. The same WBIDs are also the assessment units identified in the FDEP's biannual lists of impaired waters submitted to EPA as part of their reporting under Section 303(d) of the Clean Water Act.

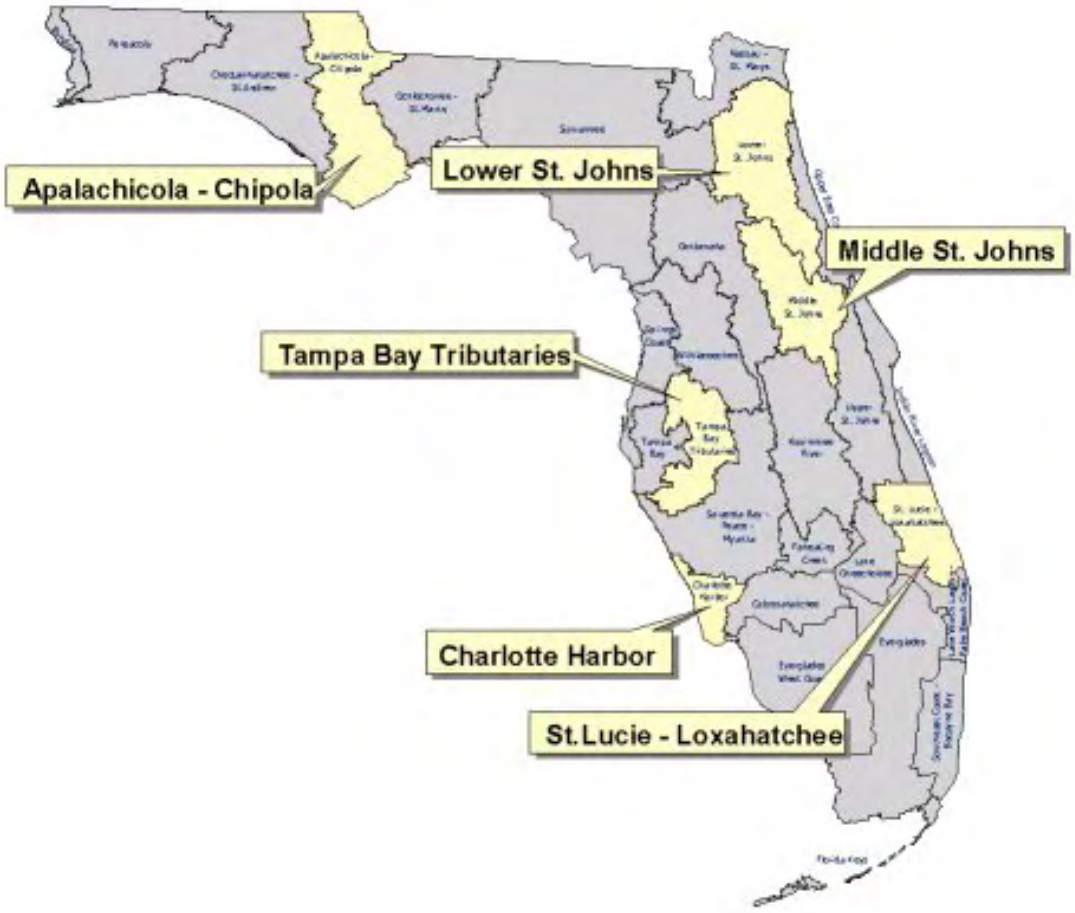

Figure 1: FDEP Group 2 River Basins

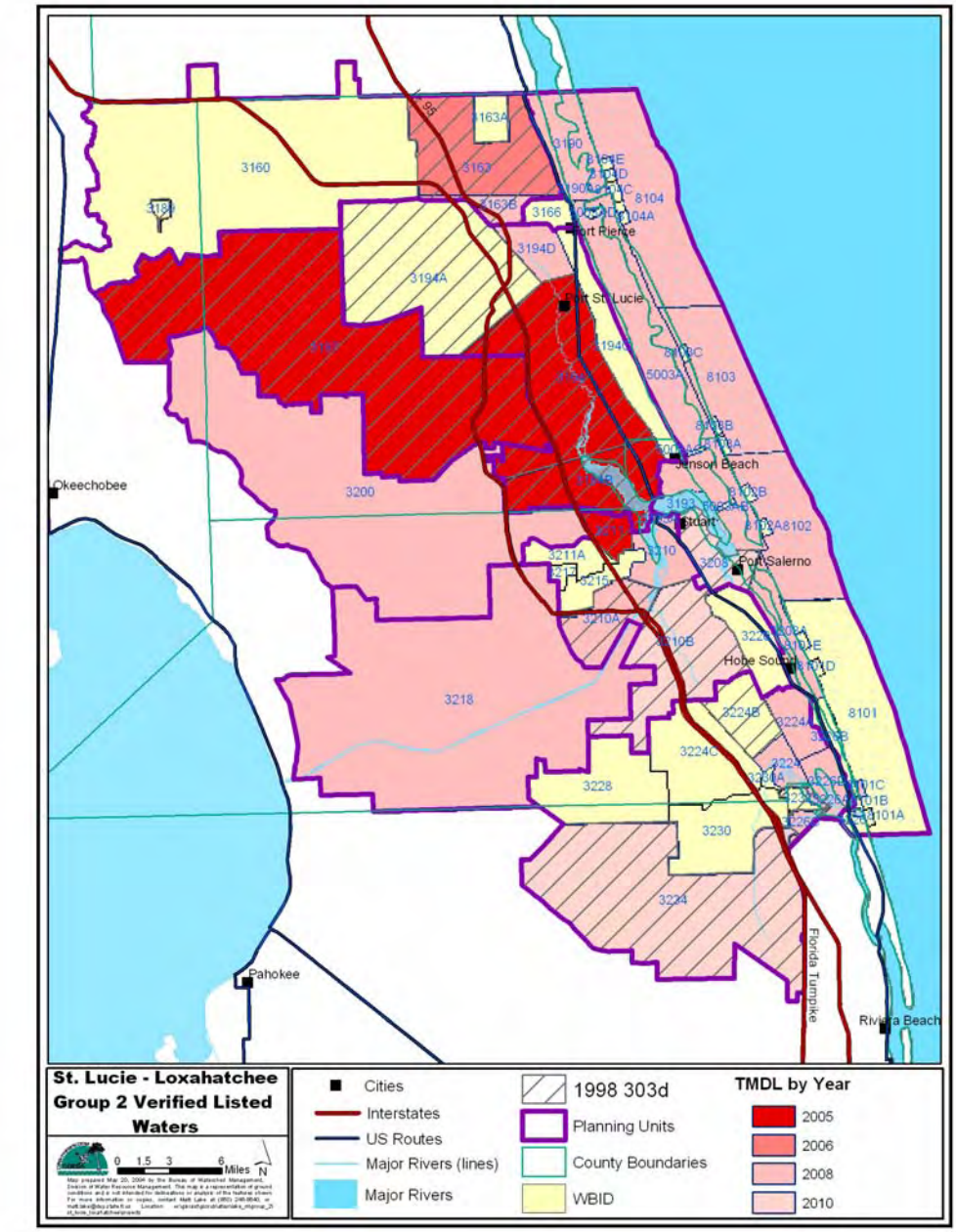

Figure 2: St. Lucie / Loxahatchee River Basin. WBIDs 3160 and 3189 are on the 1998 303(d) list for Fecal Coliform.

2. PROBLEM DEFINITION

Florida's final 1998 Section 303(d) list identified WBIDs 3160 and 3189 in the St. Lucie River Basin as not supporting water quality standards (WQS) due to coliform bacteria. After assessing all readily available water quality data, EPA is responsible for developing a fecal coliform TMDL in WBID 3160, C-25 Canal West and WBID 3189, C-25 Cowbone Creek. The location of WBIDs 3160 and 3189 are shown in Figure 2. The TMDLs addressed in this document are being proposed pursuant to EPA commitments in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998).

WBIDs 3160 and 3189 are designated as a Class III fresh water. The designated use of Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Class III waters are further categorized based on fresh or marine waters. Water quality criteria for fecal and total coliform do not vary between Class III fresh or marine waters.

3. WATERSHED DESCRIPTION

As discussed in the introduction, FDEP manages water resources based on river basins. The river basins are organized from large groups of major river basins to smaller watersheds called planning units, and finally to small waterbody polygons called WBIDs. The St. Lucie River Basin, C-25 Canal Planning Unit, and C-25 Canal West and Cowbone Creek WBIDs are described next. The following information is from the 2003 FDEP Basin Status Report for St. Lucie and Loxahatchee. In the St. Lucie Basin, most of the land in the non-coastal areas is used for the production of citrus and beef cattle. The extensive network of canals that drain these agricultural areas transport storm-water runoff containing nutrients, sediment, bacteria, and other pollutants. These reach the natural drainage-ways (such as the North and South Forks of the St. Lucie River) and ultimately the St. Lucie Estuary and the South Indian River Lagoon. The St. Lucie Canal (C-44), the inland waterway that connects Lake Okeechobee to Florida's east coast, transports regulated releases of water from Lake Okeechobee and runoff from agricultural areas within the C-44 basin. Other major canals also transport storm-water from inland agricultural areas to the estuary. Canals C-23 and C-24 discharge water into the North Fork of the St. Lucie River and the C-25 Canal discharges to the Indian River Lagoon. These canals transport loads of nutrients and eroded sediment to the estuary and slugs of fresh water that create fluctuations in estuarine salinity levels. Urban and residential areas continue to expand in the coastal areas, with polluted urban storm-water runoff and seepage from septic tanks also contributing to the water quality problems in streams and canals. As a result, parts of the St. Lucie Estuary (SLE) appear to be impaired by nutrients, copper, and low levels of DO. Nutrient loads, salinity fluctuations, and accumulations of sediment stress the estuarine ecology. Other evidence of impairment was gathered for the SLE segments in a FDEP South East District biological survey (Graves et al., June 2002). Sediment accumulation, decline of sea-grasses and oysters, algal blooms, fish kills, and low diversity of benthic macroinvertebrates in the SLE comprise this body of evidence.

WBIDs 3160 and 3189 are in the C-25 Canal planning unit of the St. Lucie Basin. These two WBIDs are covered by this TMDL report since WBID 3189 is surrounded by and flows into WBID 3160. The planning unit includes the watershed of the C-25 Canal (also known as Belcher Canal), which transports water eastward across northern St. Lucie County from near the St. Lucie-Okeechobee County border. It includes the C-25, Basin 1, and C-25 East subbasins that are defined by SFWMD. The USGS includes all of these but Basin 1 in the Southeast Florida Coast hydrologic unit. Basin 1 lies in the Indian River South hydrologic unit, as defined by USGS. The planning unit includes a complex network of canals primarily for agricultural drainage that has created a conveyance for discharge to the IRL. Runoff from the western part of the planning unit can discharge southward to the C-24 Canal via the C-25 extension (C-25 EXT). Runoff from the eastern and central portions of this subbasin is conveyed eastward through the S-99 structure on the C-25 Canal. Basin 1, east of S-99, receives drainage from the Ft. Pierce Farms Water Control District (WCD) that was established under Chapter 298, Laws of Florida. The Ft. Pierce Farms WCD Canal #1 is the primary surface water conveyance for Basin 1, providing drainage of the agricultural area and inhibiting saltwater intrusion. Canal #1 and C-25 discharge into the South IRL through the mouth of Taylor Creek at Ft. Pierce. The eastern part of this planning unit includes the northern edge of the Ft. Pierce city limits. Figure 3 is a composite map of this planning unit that shows
potentially impaired waters and potential point sources of pollution.

Approximately 10 percent of the planning unit area is defined as wetland and 15 percent listed as pine flatwoods. The largest contiguous wetland area, an extension of the St. Johns Marsh, is located in the northwestern corner of St. Lucie County. One state-managed natural area exists in the C-25/Basin 1 planning unit. The Green Swamp Preserve is located in the northwestern corner. Most waterbodies within this planning unit are agricultural canals used for drainage and/or irrigation that feed the conveyance system provided by C-25 and other SFWMD canals. Although classified as Class III waters, canals are not capable of supporting the diverse ecosystems characteristic of natural streams.

The C-25/Basin 1 planning unit is primarily an agricultural area. Efforts to reduce pollutant loadings to storm-water from individual agricultural land holdings are tied to the active participation of local citrus growers and cattlemen in agricultural best management practices (BMP). These actions are assisted by Department of Agriculture and Consumer Services, University of Florida Institute of Food and Agricultural Science, U.S. Department of Agriculture Natural Resources Conservation Service, and the FDEP. Under the Indian River Lagoon South Feasibility Study, a regional water storage reservoir and a storm-water treatment area (STA) are proposed within this unit. This project will include a 741-acre aboveground reservoir and a 163-acre STA at the S-99 structure on the C-25 Canal. The system will be used to capture local runoff from the C-25 subbasin and the Ft. Pierce Farms WCD. The purpose of this component is to provide peak flow attenuation, a water supply for irrigation, and reductions in concentrations of nutrients, pesticides, and other contaminants. Water quality will be improved in the canal east of the STA and the southern Indian River Lagoon.

WBID 3160 is a large polygon of over 96,000 acres that surrounds the much smaller WBID 3189

that contains only 741 acres. Cowbone Creek is a channelized stream system in the western part of the planning unit that makes up WBID 3189. Cowbone Creek is included on the 1998 303(d) list for coliform, nutrients, and low DO. Land cover in WBIDs 3160 and 3189 is mostly agriculture and wetlands, with about 81 and 52 percent agriculture and 12 and 43 percent wetlands, respectively. The land cover distribution for this and other cover types is shown in Table 1 for WBID 3160 and Table 2 for WBID 3189. WBID 3160 includes most of the C-25 Canal planning unit.

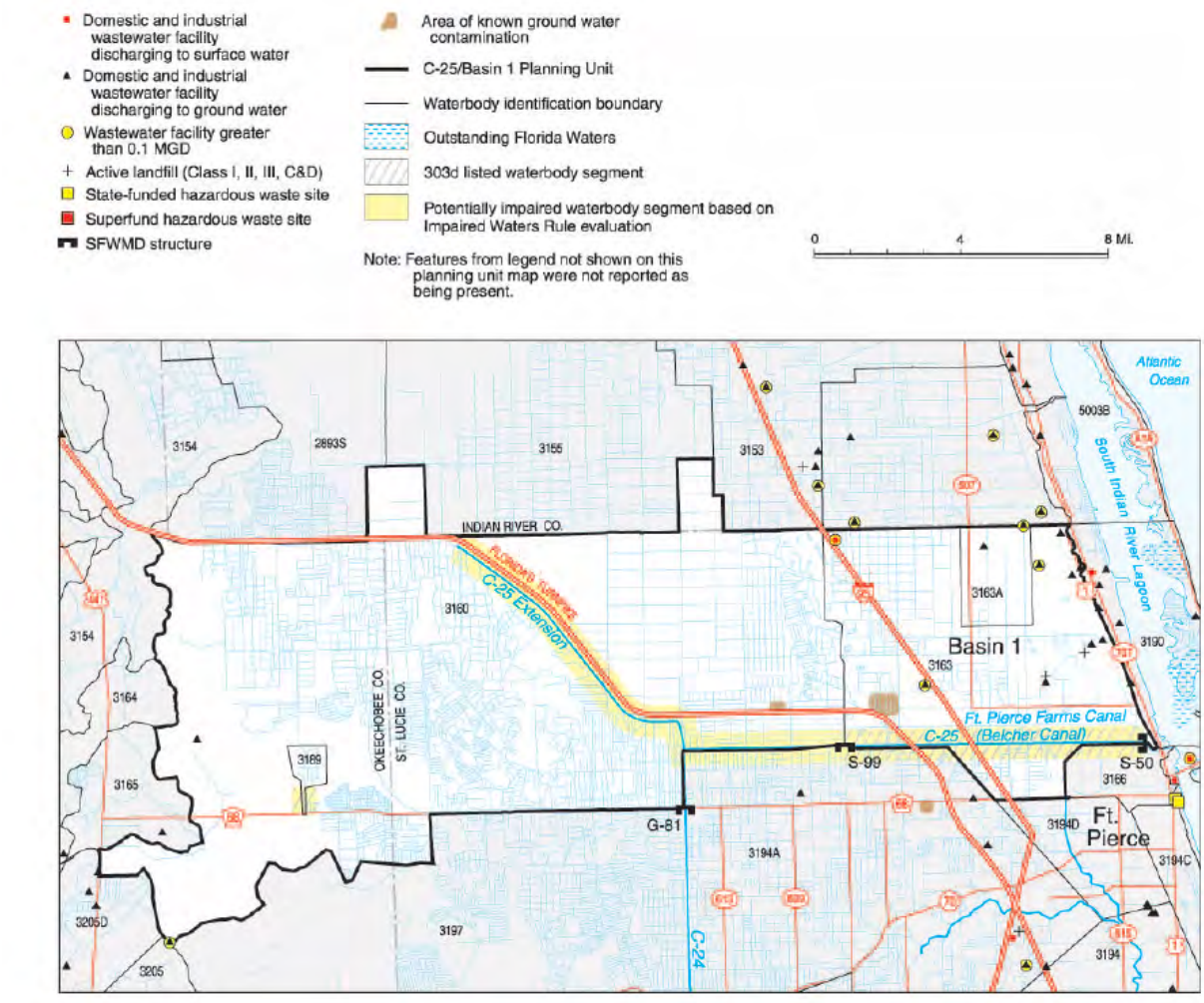

Figure 3: C-25 Planning Unit

Table 1: Land Cover Distribution for WBID 3160 in acres and percentage.

Land Cover	Acreage	Percentage
Residential (1100-1390)	260	0%
Commercial, Industrial, Public (1400, 1500, 1800)	42	0%
Agriculture (2000 series)	78448	81%
Rangeland (3000 series)	686	1%
Forest (4000 series)	1074	1%
Water (5000 series)	3022	3%
Wetlands (6000 series)	11278	12%
Barren & Extractive (7000, 1600)	1063	1%
Transportation & Utilities (8000 series)	563	1%
TOTAL (acres)	96436	

Table 2: Land Cover Distribution for WBID 3189 in acres and percentage.

Land Cover	Acreage	Percentage
Residential (1100-1390)	0	0%
Commercial, Industrial, Public (1400, 1500, 1800)	0	0%
Agriculture (2000 series)	386	52%
Rangeland (3000 series)	0	0%
Forest (4000 series)	21	3%
Water (5000 series)	12	2%
Wetlands (6000 series)	322	43%
Barren & Extractive (7000, 1600)	0	0%
Transportation & Utilities (8000 series)	0	0%
TOTAL (acres)	741	

4. WATER QUALITY STANDARD FOR FECAL COLIFORM BACTERIA , AND TARGET IDENTIFICATION

The water quality criteria for protection of Class III waters are established by the State of Florida in the Florida Administrative Code (F.A.C.), Section 62-302.530. The individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C. [Surface Waters: Minimum Criteria, General Criteria] that apply to all waters unless alternative or more stringent criteria are specified in F.A.C. Section 62-302.530.

Fecal coliforms are a subset of the total coliform group and indicate the presence of fecal material from warm-blooded animals. Total coliform bacteria generally indicate the presence of soil-associated bacteria and result from natural influences on a water body such as rainfall runoff as well as sewage inflows. The most probable number (MPN) or membrane filter (MF) counts per 100 milliliter (ml) of fecal coliform bacteria shall not exceed a monthly average of 200, nor

exceed 400 in 10 percent of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. The geometric mean criteria reflect chronic or long-term water quality conditions whereas the 400 and 800 values reflect acute or short-term conditions.

The target for this TMDL is the daily 800 counts per 100 ml and the "not to exceed 400 in 10 percent of the samples" criteria, since enough monthly data was not collected to evaluate the monthly average 200 criteria. When flow data are available in the WBID, the fecal coliform TMDLs are expressed as daily loads in units of MPN per day. The fecal coliform TMDLs are also expressed in terms of the percent reduction required to achieve water quality standards. When flow data are not available in the WBID or due to hydrologic and/or geologic conditions it is not possible to estimate flow (i.e., tidal influence or karst geologic formation), the TMDLs are expressed only as percent reductions.

It is appropriate to use the more stringent of the acute criteria for fecal coliform TMDL development since the data indicates violations of the standard are typically related to storm events, which are short-term in nature. Violations of the chronic criteria are typically associated with point sources or non-point source continuous discharges (e.g., leaking septic systems) and typically occur during all weather conditions. Targeting the acute criteria should be protective of the chronic criteria.

5. WATER QUALITY ASSESSMENT

To determine the status of surface water quality in Florida, three categories of data – chemistry data, biological data, and fish consumption advisories – were evaluated to determine potential impairments. The level of impairment is defined in the Identification of Impaired Surface Waters Rule (IWR), Section 62-303 of the Florida Administrative Code (F.A.C.). The IWR defines FDEP's threshold for identifying water quality limited WBIDs to be included on the state's 303 (d) list. In addition, all waters on the 1998 303 (d) list that were not delisted remain on the current 303 (d) list and require TMDLs. The WBIDs 3160 and 3189 are on FDEP's planning list for fecal coliform bacteria. EPA assessed these WBIDs and concluded that they are impaired, and fecal coliform TMDLs must be developed.

FDEP maintains ambient monitoring stations throughout the basin. All data collected at monitoring stations within the impaired WBIDs are used in the analysis. Table 3 provides a list of the monitoring stations and shows that 12 of the samples were from Cowbone Creek and 2 samples were from other waters in the WBIDs. All of this data was used in developing the TMDL for WBID 3160 (see Table 3), and only the 12 observations from Cowbone Creek were used in the TMDL for WBID 3189 (see Table 4). Data from this Cowbone Creek station is used for both TMDLs since the station is located in WBID 3160 just downstream of WBID 3189. Table 5 and Table 6 summarize the fecal coliform monitoring data used to determine the TMDLs and show that 86 and 92 percent of the observations exceed the 400 counts per 100 ml threshold for WBIDs 3160 and 3189, respectively.

Table 3: Monitoring Stations used in the Development of the Fecal Coliform TMDL for WBID 3160

Station ID	Station Name	Number of Observations
21FLA 26010429	COWBONE CREEK AT SR 68	12
21FLGW 20026	SFB-SS-1054 UNNAMED SMALL STREAM	1
21FLGW 20105	SFB-LL-1013 UNNAMED LARGE LAKE	1

Table 4: Monitoring Stations used in the Development of the Fecal Coliform TMDL for WBID 3189

Station ID	Station Name	Number of Observations
21FLA 26010429	COWBONE CREEK AT SR 68	12

Table 5. Summary of Fecal Coliform Monitoring Data in WBID 3160

Number of Samples	30-Day Geometric Mean[1]	% Samples > 400 (MPN/100mL)	% Samples > 800 (MPN/100mL)	Minimum Concentration (MPN/100mL)	Maximum Concentration (MPN/100mL)
14	N/A	86%	50%	10	17,100

Notes:

1. N/A = not applicable since less than 10 samples collected within a 30-day period to evaluate criteria.

Table 6. Summary of Fecal Coliform Monitoring Data in WBID 3189

Number of Samples	30-Day Geometric Mean[2]	% Samples > 400 (MPN/100mL)	% Samples > 800 (MPN/100mL)	Minimum Concentration (MPN/100mL)	Maximum Concentration (MPN/100mL)
12	N/A	92%	50%	180	17,100

Notes:

2. N/A = not applicable since less than 10 samples collected within a 30-day period to evaluate criteria.

WBID 3160, C-25 Canal

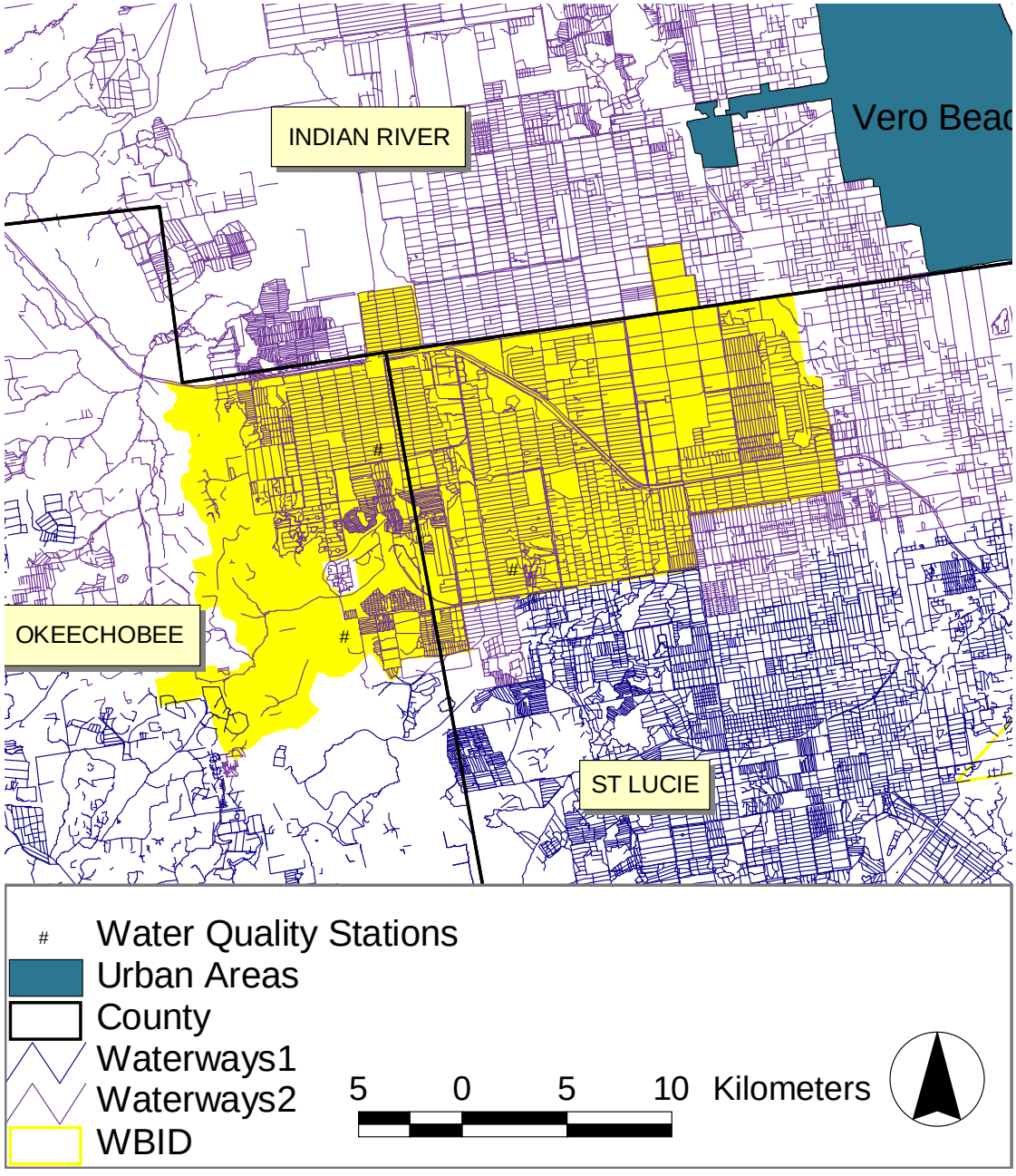

Figure 4: Water Quality Monitoring Stations in WBID 3160, C-25 Canal

6. SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of coliform bacteria in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point or non-point sources.

A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System (NPDES) permits. NPDES permitted facilities discharging treated sanitary wastewater or stormwater (i.e., Phase I or II MS4 discharges) are considered primary point sources of coliform.

Non-point sources of coliform are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation of bacteria on land surfaces and wash off as a result of storm events. Typical non-point sources of coliform include:

- Wildlife
- Agricultural animals
- Onsite Sewer Treatment and Disposal Systems (septic tanks)
- Urban development (outside of Phase I or II MS4 discharges)

A geographic information system (GIS) tool, was used to display, analyze, and compile available information to characterize potential bacteria sources in the impaired WBID. This information includes land use, point source dischargers, soil types and characteristics, population data (human and livestock), and stream characteristics.

6.1. Point Sources

In this planning unit, FDEP records indicate that there are 12 permitted wastewater treatment facilities, only one of which discharges directly to surface water. The facility having the largest design flow is the Spanish Lake Fairways Reverse Osmosis Plant, which is permitted for a design capacity of 0.78 million gallons per day (mgd) and has an industrial wastewater permit to discharge to surface water. This is a water supply facility that is not expected to discharge fecal coliforms, and the discharge is outside of WBIDs 3160 and 3189. The other NPDES permitted facility is the Larson Dairy Barn #3 (FLA139254), which is a confined animal feeding operation (CAFO) that discharges to a spray irrigation land application site in the Gomez Creek watershed

within WBID 3160. Gomez Creek is a tributary to Cowbone Creek, and therefore this facility is a potential source of pollutants in both WBID 3160 and 3189. The second largest treatment facility is for Spanish Lakes Fairways domestic wastewater discharge, which has design capacity of 0.25 mgd, but does not discharge directly to surface water. Other potential point sources include landfills. There is one Class I solid waste landfill in the planning unit, which is currently not in operation. There are no state-funded or federal (National Priorities List [NPL]) hazardous waste cleanup sites within this planning unit, although there are 2 delineated areas of ground water contamination for the agricultural chemical ethylene dibromide (EDB). Also, according to FDEP records, there have been more than 50 reported discharges from petroleum storage facilities in the planning unit. Figure 3 shows permitted wastewater treatment facilities, landfills, and delineated ground water contamination areas in the planning unit. As shown in the figure, most of the above facilities are in the eastern part of the planning unit and not in WBID 3160 or 3189. The only point source in either WBID is the Larson Dairy Barn in WBID 3160.

Municipal Separate Storm Sewer Systems (MS4s) may also discharge bacteria to water-bodies in response to storm events. Large, medium, and small MS4s serving populations greater than 50,000 people, or with an overall population density of 1,000 people per square mile, are required to obtain a NPDES storm water permit. There are three MS4 permits in St. Lucie County, five in Indian River County, and none in Okeechobee County. Only the St. Lucie County MS4 (FLR04E029) and the Indian River County MS4 (FLR04E068) are near WBID 3160 and are likely to discharge in the WBID. There are no MS4s near WBID 3189.

6.2. Non-point Sources

Based on Level I and Level II land use summary information (SFWMD, 1995), the predominant land use in the C-25/ Basin 1 planning unit is agriculture (approximately 65 percent of area). The agricultural lands are used for cultivation of citrus (approximately 34 percent of planning unit area) and improved pasture (approximately 28 percent of area). Only 5 percent of the planning unit area is designated as urban/built-up. These land uses can be associated with nonpoint discharges of pollutants and eroded sediments.

6.3. Wildlife

Wildlife deposit bacteria in their feces onto land surfaces where it can be transported during storm events to nearby streams. Bacteria load from wildlife is assumed background, since the contribution from this source is small relative to the load from urban and agricultural areas. Water fowl (e.g., egrets, ducks, wood storks, herons) often frequent storm-water ponds. Depending on the number of birds, the contributions of fecal coliform could result in stream concentrations above the criteria.

6.4. Agricultural Animals

Agricultural animals are the source of several types of coliform loadings to streams, that impact water quality. This source includes agriculture runoff from pastureland and cattle in streams. The land use within the impaired WBIDs is 81 and 52 percent agricultural (Table 1 and Table 2), so this landuse likely discharges a significant amount of the bacteria load.

The USDA National Agricultural Statistics Service (NASS) compiles Census of Agriculture data by county for virtually every facet of U.S. agriculture (USDA, 2002). The "Census of Agriculture Act of 1997" (Title 7, United States Code, Section 2204g) directs the Secretary of Agriculture to conduct a census of agriculture on a 5-year cycle collecting data for the years ending in 2 and 7. In 2002, NASS reported 221,537 acres of farmland in St. Lucie County, 191,333 acres in Indian River County, and 392,495 acres in Okeechobee County. Livestock inventory from the 2002 Census of Agriculture reports are listed in Table 7. Cattle and calves are the predominate livestock. Confined Animal Feeding Operations (CAFOs) are not known to operate in either St. Lucie or Indian River County. However, dairy farm CAFOs, such as the Larson Dairy discussed previously under point sources, are present in Okeechobee County. Concentrated Animal Feeding Operations (CAFOs) are point sources, as defined by the CWA [Section 502(14)]. To be considered a CAFO, a facility must first be defined as an Animal Feeding Operation (AFO). Animal Feeding Operations (AFOs) are agricultural operations where animals are kept and raised in confined situations. AFOs generally congregate animals, feed, manure, dead animals, and production operations on a small land area. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures. Animal waste and wastewater can enter water bodies from spills or breaks of waste storage structures (due to accidents or excessive rain), and non-agricultural application of manure to crop land. AFOs that meet the regulatory definition of a concentrated animal feeding operation (CAFO) have the potential of being regulated under the NPDES permitting program.

Table 7. Livestock Inventory by County (source: NASS, 2002)

Livestock (inventory)	St. Lucie	Okeechobee	Indian River
Cattle and calves	31,944	142,656	25,139
Hogs and Pigs	394	82	271

6.5. Onsite Sewerage Treatment and Disposal Systems (Septic Tanks)

Onsite sewage treatment and disposal systems (OSTDs) including septic tanks are commonly used where providing central sewer is not cost effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDs are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTD is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs can be a source of nutrient (nitrogen and phosphorus), pathogens, and other pollutants to both ground water and surface water. The State of Florida Department of Health (www.doh.state.fl.us/environment/ostds/statistics/ostdsstatistics.htm) publishes septic tanks data on a county basis. Table 8 summarizes the cumulative number of septic systems installed since the 1970 census. The data does not reflect septic tanks removed from service.

Table 8. County Estimates of Septic Tank Installations (FDEP, 2004)

County	Number Septic Tanks (1970- 2002)
St. Lucie	43,022
Indian River	34,174
Okeechobee	11,432

6.6. Urban Development

Fecal coliform loading from urban areas is attributable to multiple sources including storm-water runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of non-point source pollution by requiring new development and redevelopment to treat storm-water before it is discharged. The Stormwater Rule, as outlined in Chapter 403 Florida Statutes (F.S.), was established as a technology-based program that relies upon the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C. Florida's stormwater program is unique in having a performance standard for older storm-water systems that were built before the implementation of the Stormwater Rule in 1982. This rule states: "the pollutant loading from older storm-water management systems shall be reduced as needed to restore or maintain the beneficial uses of water" (Section 62-4-.432 (5) (c), F.A.C.).

Nonstructural and structural BMPs are an integral part of the State's storm-water programs. Nonstructural BMPs, often referred to as "source controls", are those that can be used to prevent the generation of NPS pollutants or to limit their transport off-site. Typical nonstructural BMPs include public education, land use management, preservation of wetlands and floodplains, and minimizing impervious surfaces. Technology-based structural BMPs are used to mitigate the increased storm-water peak discharge rate, volume, and pollutant loadings that accompany urbanization.

7. ANALYTICAL APPROACH

The approach for calculating coliform TMDLs depends on the number of water quality samples and the availability of flow data. When long-term records of water quality and flow data are not available, the TMDL is expressed as a percent reduction. Load duration curves are used to develop TMDLs when significant data are available to develop a relationship between flow and concentration. Load duration curves utilize a mass balance approach to estimate loadings transported in the stream. For the load duration curve TMDLs, the target is the acute criteria. Since only 14 water quality measurements were available, these fecal coliform TMDLs are

expressed as a percent reduction. As discussed previously in the Water Quality Assesssment Section of this report, all of the water quality data was used in developing the TMDL for WBID 3160 (see Table 3), and only the 12 observations from Cowbone Creek were used in the TMDL for WBID 3189 (see Table 4). Data from this Cowbone Creek station is used for both TMDLs since the station is located in WBID 3160 just downstream of WBID 3189.

7.1. Percent Reduction Approach for TMDL Development

Under this "percent reduction" method, the percent reduction needed to meet the applicable criterion is calculated based on a percentile of all measured concentrations. The (p X 100) percentile is the value with the cumulative probability of p. For example, the 90^{th} percentile has a cumulative probability of 0.90. The 90^{th} percentile is also called the 10 percent exceedance event because it will be exceeded with the probability of 0.10. Therefore, considering a set of water quality data, 90 percent of the measured values are lower than the 90^{th} percentile concentration and 10 percent are higher. Since the water quality standard states the fecal coliform concentration shall not exceed 400 counts per 100 ml in 10 percent of the samples, 400 should be targeted with a percentile slightly larger than 90 to ensure less than 10 percent of the values exceed 400. For this TMDL, 400 counts per 100 milliliter was targeted as the 95^{th} percentile. This will meet the water quality standard and provide a margin of safety by ensuring that only 5 percent of the data exceed a concentration of 400. There are many formula for determining the percentile and these can be found in many text books on statistics. In these TMDLs the Hazen formula was used since it is recommended in Hunter's Applied Microbiology (2002) article concerning bacteria in water. The TMDL percent reduction required to meet the coliform criteria is based on the following equation:

Percent Reduction = (existing 95^{th} percentile concentration – criteria) / existing 95^{th} percentile concentration × 100 (Equation 1)

For WBID 3160, the existing 95^{th} percentile concentration is 13,936 MPN/100ml, and a 97 percent reduction is necessary to meet the water quality target of 400 MPN/100 ml 95 percent of the time. The "not to exceed 800" standard would result in a reduction of about 95 percent because of the maximum reported value of 17,100 counts per 100 ml. The 97 percent reduction is selected for the TMDL to comply with both water quality standards.

For WBID 3189, the existing 95^{th} percentile concentration is 15,518 MPN/100ml, and a 97 percent reduction is necessary to meet the water quality target of 400 MPN/100 ml 95 percent of the time. The "not to exceed 800" standard would result in a reduction of about 95 percent because of the maximum reported value of 17,100 counts per 100 ml. The 97 percent reduction is selected for the TMDL to comply with both water quality standards.

8. DEVELOPMENT OF TOTAL MAXIMUM DAILY LOADS

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between

pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measures. TMDLs for the C-25 WBIDs 3160 and 3189 are expressed as a percent reduction.

8.1. Critical Conditions

The critical condition for non-point source coliform loading is an extended dry period followed by a rainfall runoff event. During the dry weather period, coliforms build up on the land surface, and are washed off by rainfall. The critical condition for point source loading occurs during periods of low stream flow when dilution is minimized. Water quality data have been collected during both climate conditions. Critical conditions are accounted for in the analyses by using all water quality data available for the WBIDs.

8.2. Margin of Safety

TMDLs shall include a margin of safety that takes into account any lack of knowledge about the pollutant loading and in-stream water quality. In this case, the measured water quality was used directly to determine the reduction to meet the water quality standard. In this case the lack of knowledge concerns the data, how well it represents the true water quality, and the estimation of the exceedance probability. There are two methods for incorporating a MOS in the analysis: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. In these TMDLs, an implicit MOS was used by targeting reductions that will result in no more than 5 percent of the samples exceeding a concentration of 400 counts per 100 ml even though the standard requires less than 10 percent exceedance. In addition, this TMDL requires a very high reduction of 97 percent.

8.3. Determination of TMDL, LA and WLA

The TMDL values represent the maximum daily load the stream can assimilate and maintain water quality standards. The TMDLs are based on the daily 800 counts per 100 ml and the “not to exceed 400 in 10 percent of the samples” Class III WQS, and are expressed in units of MPN (counts) per day. TMDL components for the impaired water-bodies required to achieve the numerical criterion are summarized in Table 9.

Table 9. Summary of TMDL Components

Stream Name / WBID	Parameter	WLA		LA	TMDL	Percent Reduction
		FLA139254	MS4			
C-25 Canal (3160)	Fecal Coliform	0 counts per 100 ml	97% reduction	97% reduction	97% reduction	97% reduction
C-25 Canal (3189)	Fecal Coliform	N/A	N/A	97% reduction	97% reduction	97% reduction

8.4. Waste Load Allocations

The waste load allocation for the Larson Dairy Barn #3 (FLA139254), which is a CAFO that discharges to a spray irrigation land application site in the Gomez Creek watershed of WBID 3160, is zero. CAFOs have management plans that describe how the waste will be treated so that no waste water is discharged. Therefore, the waste load allocation of fecal coliform is zero. The waste load allocation for municipally separated storm sewer systems contributing pollutants to WBID 3160 is a 97 percent reduction from existing loads. There are two MS4 permits near WBID 3160. These are St. Lucie County MS4 (FLR04E029) and Indian River County MS4 (FLR04E068).

8.5. Load Allocations

There are two modes of transport for non-point source coliform bacteria loading into the stream. First, fecal coliform loading from failing septic systems and animals in the stream are considered direct sources of coliform to the stream, since they are independent of precipitation. The second mode involves coliform loadings resulting from accumulation on land surfaces transported to streams during storm events. Data from these WBIDs shows violations during wet weather and dry weather, so both direct and indirect sources should be targeted by the reductions.

8.6. Seasonal Variation

Seasonality was addressed by using all water quality data associated with the impaired WBIDs, which was collected during multiple seasons.

8.7. Recommendations

Determining the source of bacteria in waterbodies is the initial step to implementing a coliform TMDL. FDEP employs the Basin Management Action Plan (B-MAP) as the mechanism for developing strategies to accomplish the necessary load reductions. Components of a B-MAP are:

- Allocations among stakeholders
- Listing of specific activities to achieve reductions
- Project initiation and completion timeliness
- Identification of funding opportunities
- Agreements
- Local ordinances
- Local water quality standards and permits

- Follow-up monitoring

9. REFERENCES

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APPENDIX A: WATER QUALITY REMARK CODES

Table 10: Guide to Water Quality Remark Codes (Rcode column in data tables)

Remark Code	Definition	Use in TMDL
A	Value reported is mean of two or more samples	Data included in analysis as reported
B	Result based on colony counts outside the acceptable range	Data included in analysis as reported
E	Extra sample taken in compositing process	Data included as average
I	The value reported is less than the practical quantification limit and greater than or equal to the method detection limit.	Data included in analysis as reported
J	Estimated. Value shown is not a result of analytical measurement.	Data included in analysis as reported
K	Off-scale low. Actual value not known, but known to be less than value shown	Data included in analysis as reported
L	Off-scale high. Actual value not known, but known to be greater than value shown	Data included in analysis as reported
Q	Sample held beyond normal holding time	Data used in analysis – holding samples on ice slows the metabolism of the organisms resulting in no appreciable growth. Actual concentration is expected to be at least as high as the value reported.
T	Value reported is less than the criteria of detection	Data included in analysis if the reported value is below criteria; otherwise, reported value is not used in the analysis
U	Material was analyzed for but not detected. Value stored is the limit of detection.	Data not included in analysis
<	NAWQA – actual value is known to be less than the value shown	Data included in analysis
Z	Too many colonies were present to count (TNTC), the numeric value represents the filtration volume	Data not included in analysis